



Case Series



Terrible triad injury of the elbow: A PROCESS-compliant surgical case series from Eastern Morocco

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ABSTRACT

Introduction: The terrible triad of the elbow (TTE) is a lesion associating a dislocation of the elbow, a fracture of the radial head, and a fracture of the coronoid process, with a high potential of complication. The treatment is based on the restoration of bone lesions and external capsular ligament repair. The systematic repair of the medial collateral ligament (MCL) is still debated in the literature. The aim of this study is to evaluate the clinical and functional results of the surgical treatment in a real-world series from Eastern Morocco.

Patients and methods: This was a retrospective study of 6 cases of TTE operated by isolated external approach or combined approach (internal or anterior) of the elbow in the department of Traumatology-Orthopedics of the Mohammed VI University Hospital (Oujda Morocco), over a period of 7 years from 2013 to 2020. Radial head and coronoid process fractures were classified according to the Mason and Morrey-Regan classifications, respectively. The following clinical parameters were evaluated: Mayo Clinic Elbow Performance Score (MEPS), Quick Disabilities of the Arm, Shoulder and Hand (DASH), Visual Analog Scale (VAS), and arc of mobility in flexion-extension and pronosupination.

Results: 6 male patients treated between May 2013 and December 2020 were included. The median follow-up was 48 months. All patients had frontal and lateral standard X-ray of over and under joints, and computed tomography (CT)-scan was delivered for 5 cases. The elbow dislocation was posterolateral in five cases, and posteromedial in only one patient. Radial head fractures were classified as type I in one case, type II in two cases, and type III in three cases. Coronoid fractures were type I in three cases, type II in one case, and type III in two cases. At the last follow up, the mean MEPS, Quick DASH, and VAS was 81, 28, 0.8, respectively. The mean arc of mobility in flexion was 120° and it was deficient by 20° in extension. In addition, the mean arc of mobility in pronation was 80°, while in supination it was 75°. Regarding complications, we noticed an instability of the elbow on valgus in a single case, elbow stiffness with heterotopic ossification in a single case, ulnar nerve damage in a single case during medial collateral ligament anchoring, and elbow hygroma in one single case.

Conclusion: The surgical management of TTE can provide good and long-term functional results after restoration of the stabilization of bone structures and the lateral ligament complex, without the need to repair the medial collateral ligament.

1. Introduction

The terrible triad of the elbow (TTE) was first described in 1996 by Hotchkiss and it is a complex lesion, associating a dislocation of the elbow, a fracture of the radial head and, a fracture of the coronoid process [1], with a high potential of complication [2]. It's a serious injury, with damage to the different elements of bone and ligament that establishes elbow stability. The treatment aims to restore joint congruence and mobility. However, the identification of these lesions may be difficult and the quality of the urgent management will condition patients' outcomes [3]. The treatment of TTE is based on the restoration of bone lesions and the lateral collateral ligament (LCL) the systematic repair of the medial collateral ligament (MCL) is still debated. The aim of this real-world study is to evaluate the clinical and functional results of

the surgical treatment. To the best of our knowledge, this is the first surgical case series on this rare entity to be reported in Morocco based on Consensus Preferred Reporting Of Case Series in Surgery (PROCESS) guidelines [4].

2. Patients and methods

This was a PROCESS-compliant retrospective and single-center study of 6 cases diagnosed with TTE treated by isolated external or combined approaches (internal or anterior) of the elbow at the department of traumatology and orthopedics of the Mohammed VI University Hospital (Oujda Morocco) over a period of 7 years from 2013 to 2020. Median age of our patients was 43.67 and only one of them had a comorbidity (hypertension under single agent treatment). Radial head fractures were

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classified according to the Masson classification [1,5] and fractures of the coronoid process were classified according to the Morrey-Regan classification [1,5,6]. Before surgery, all patients were treated with first generation cephalosporin (2 g of cephalthin). Surgery was performed by a senior professor assisted by junior residents and only one case was treated by a qualified final year resident. The following clinical parameters were evaluated including Mayo Clinic Elbow Performance Score (MEPS) [7], Quick DASH, visual analog scale (VAS), arc of mobility in flexion-extension and pronosupination. Follow up of patients was performed every two weeks of the rehabilitation period (two months) and then, every three months thereafter. All patients from our database provided their consents to use their medical records for research. The study was registered on Research Registry under the number: 7795.

3. Results

Six male patients treated between May 2013 and December 2020 were included with median follow-up was 48 months. All patients had a standard frontal and lateral X-ray of over and under joints (Fig. 1) and benefited from computed tomography (CT-scan) in 5 cases (Fig. 2). The elbow dislocation was posterolateral in five cases, and posteromedial in one case (Fig. 3). Radial head fractures were classified as type I in one case, type II in two cases, and type III in three cases. Coronoid fractures were type I in three cases, type II in one case, and type III in two cases. Surgical treatment was immediately performed in five cases and delayed in one case. After reduction of the elbow dislocation by external maneuver under scope control and general anesthesia in 3 patients. Moreover, 3 patients were treated with evaluation of the stability using sedation. Stabilization of the injury was performed by an isolated lateral approach in four cases combined with a medial approach in only one case, and based on an anterior approach in one case.

The radial head was created in four cases including two patients who



Fig. 1. Standard X-ray of the elbow showing a terrible triad with type 2 fracture of the radial head associated with type 2 fracture of the coronoid process.

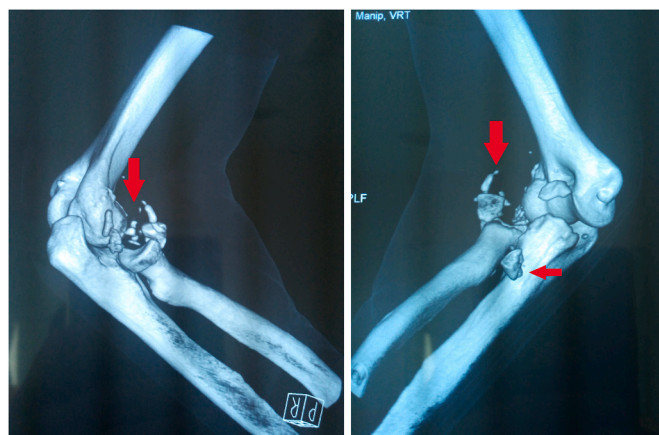


Fig. 2. CT image of the elbow showing a terrible triad with the comminution of the radial head fracture and the size of the fragment of the coronoid process.

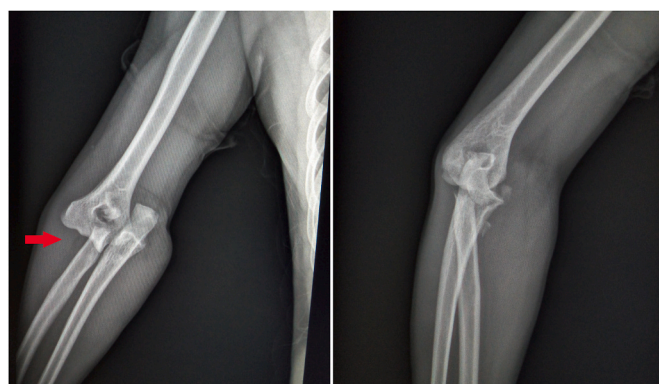


Fig. 3. Standard X-ray of the elbow showing a terrible triad of the elbow with postero-medial dislocation.

benefited from T-plate osteo-synthesis (Fig. 4), while the other two cases benefited from Herbert screw fixation (Fig. 5). In two cases, the head was none synthesizable and the patients underwent total head resection (Fig. 6). Synthesis of the coronoid process was performed by resection in two cases and the fragment was fixed by osteo-suture in three cases. The lateral ligament complex was repaired either by simple trans osseous stitches or by anchoring. The medial ligament plane was repaired in only one case by an anchoring approach.

Postoperatively, the elbow was immobilized with a 90° flexion splint. Rehabilitation was started from the first week in a protected mobility area depending on the stability obtained. In addition, valgus and varus complications were avoided during the phase of ligament healing and bone consolidation in all patients. Consolidation was continued during the first six to eight weeks while increasing the range of mobility by 10° per week. This was further supported with a muscle strengthening program that was started after the third month to strengthen the stabilization role of the periarticular muscles. After an average follow-up of 48 months, we noticed a valgus instability of the elbow in only one case. We also observed a stiffness of the elbow with peri-articular ossification in another case who were successfully treated by surgical arthrolysis of the elbow under arthroscopy. Moreover, a damage of the ulnar nerve during the anchoring of the medial collateral ligament was identified in one case and a hygroma of the elbow in another patient. During the latest follow up, the means of MEPS, Quick DASH, and VAS were 81, 28, and 0.8, respectively. The mean arc of mobility in flexion was 120°, and deficient by 20° in extension. On the other hand, the mean arc of mobility in pronation was 80°, it was 75° while in supination (Fig. 7).



Fig. 4. Intraoperative scope control of radial head osteosynthesis with mini-plate.

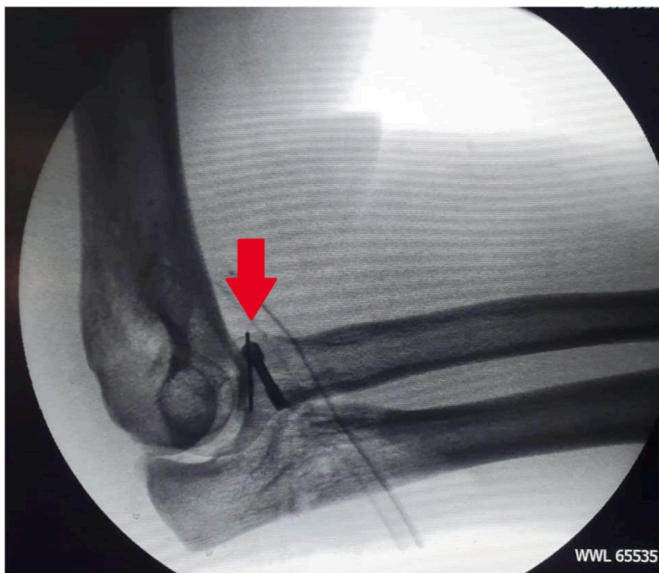


Fig. 5. Intraoperative scope control of radial head osteosynthesis with Herbert screw.

4. Discussion

Hotchkiss terrible triad refers to a lesion associating an elbow dislocation, a coronoid process fracture, and a radial head fracture [1]. This triad follows most often a trauma in axial compression with the forearm being in supination [2,4]. It is a rare entity representing only 10% of elbow fractures according to Van Riet and Morrey [5]. However,



Fig. 6. Intraoperative image of radial head resection.



Fig. 7. Functional outcome in a patient operated for a terrible triad.

it is the most serious and difficult injury to manage given that acute instability episode is associated to the particularly high risk of instability and secondary arthrosis [2]. This trauma also leads to extensive lesions of the radial collateral ligament complex, which will spread to the joint capsule, reaching the ulnar collateral compartment. The surgical treatment of the TTE requires a complete repair of the stabilizing bone structures (radial head and coronoid process) and ligaments. The aim of surgery is to restore the integrity and the stability of the ulno-humeral and radio-humeral joints, and to also reduce them to enable early postoperative mobilization and therefore, limit the flexion-extension contractures [6,7]. In addition to standard X rays, a CT scan should be performed after reduction of the dislocation to evaluate the various bone lesions and guide the therapeutic strategy [3]. Several authors recommended systematic reconstruction of the radial head, the coronoid process, and the lateral ligament plane to limit complications [8]. In our series, two radial heads were resected with no effect on stability.

The radial head represents an important element of stability in forced valgus and posterior translation. Thus, type II radial head fractures and also type III fractures should be well-preserved and synthesized. However, in non-synthesizable comminuted fractures, prosthetic replacement enables a reconstruction of the lateral stability column [9]. The rupture of the medial collateral ligament, which is common in elbow dislocation, gives the radial head an important stabilizing role [10]. Thus, resection of the radial head alone is contraindicated in the terrible triad because it increases the risk of valgus instability of the elbow and severe osteoarthritis [11].

The key element of the anteroposterior stability of the humero-ulnar joint is the coronoid process. Morrey and colleagues [12] reported that at least 50% of the apophyseal height is required to ensure humero-ulnar stability. Several other authors have studied lesions of the coronoid process associated with terrible triads and have concluded that they are

most often type I fractures that can be neglected without affecting joint stability. However, other authors proposed a reinsertion using lacing or anchoring approaches. In other surgical series [13], 93% of type I fractures were neglected. Type II or III fractures require good osteosynthesis by bracket plate or direct screw fixation [12]. This osteosynthetic strategy can be performed medially, anteriorly, or externally if the resection of the radial head is indicated [14,15]. Other authors described an enlarged posterior approach offering daylight on both lateral and medial columns [16].

Regarding the attitude towards ligament repairs, McKee et al. found a radial collateral ligament injury in all cases. As this ligament is isometric, careful reinsertion at the level of the center of rotation of the elbow, located at the center of the lateral epicondyle, is necessary to avoid varus or posterolateral instability [17]. Pugh et al. [7] recommended a systematic lateral approach with osteosynthesis or radial head replacement. The anterior column is repaired either by suturing the anterior capsule or by fixing the coronoid process. The radial collateral ligament must be repaired in all cases.

A number of biomechanical studies highlighted the prominent role of the MCL in elbow stabilization [18–21]. Its rupture and humeral avulsion are almost systematic in simple or complex dislocations [11,22]. However, its systematic repair in elbow dislocation has not shown any significant improvement in long-term clinical and functional results, which remains a controversial issue in TTE [20]. Several case series found no significant improvement in outcomes with MCL repair [7,8,22]. According to these authors, repair of the MCL was not justified in cases of isolated valgus instability as long as sagittal stability in flexion and extension was assured. The decision to perform an internal approach was based on the persistence of instability in flexion-extension. The objective was to restore perfect stability within the useful range of motion of 30–130°. The use of an articulated external fixator adjusted to the center of rotation of the elbow is indicated in cases of persistent instability despite medial ligament repair [23]. The fixator allows early mobilization along a protected arch, thus limiting the risk of joint stiffness while protecting the ligament repairs and performed osteosynthesis [24]. Our case-series provided additional evidence of the impact of surgery in improving outcomes in TTE. The retrospective nature, the small sample size, the single-center experience, and the absence of a comparative control group are the limitations of our study. Additional studies from the real-world and systematic reviews of the current evidence are needed to provide actionable information for traumatologists and orthopedists to better manage this entity. After optimal follow up, all our patients were satisfied with our management.

5. Conclusion

The surgical treatment of TTE provides good long term functional results. This can be achieved after restoration of the stabilizing bone structures and the lateral ligament complex without the need to repair the MCL.

Ethical approval

Ethical approval was not needed given the retrospective nature of these case series. All patients provided their consent to use their medical records in our electronic database for research purposes.

Informed consent

Patients included in our database were all informed about the use of their data for research and gave consents accordingly.

Sources of funding

No funding was received for this research.

Research registration

Research registry 7795.

Declaration of competing interest

The authors state that they have no conflicts of interest for this case series.

Provenance and peer review

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No funding was received for this research.

Ethical approval

Not applicable to publish this research.

Consent

All patients gave their consents to publish their medical records for research purposes.

Author contribution

Doctor A. Ben Abdellah collected data and wrote the manuscript. Doctors S. Ben Salah, S. Darraz, A. Tebbaa, O. Jelti, O. Mokhtari, I. Moulay Rchid, and Y. Rachdi participated in the care of the patients and medical records writing. Professors. A. Lachkar, A. Najib, H. Yacoubi supervised the article writing and data collection.

Registration of research studies

1. Name of the registry: **Research Registry**
2. Unique Identifying number or registration ID: **7795**
3. Hyperlink to your specific registration (must be publicly accessible and will be checked): <https://www.researchregistry.com/register-now#home/registrationdetails/624f5d5203e3790024913365/>

Guarantor

Dr. Ayman Ben Abdellah (MD).

Declaration of competing interest

No conflicts of interest to declare.

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Appendix A. Supplementary data

Supplementary data to this article can be found online at <https://doi.org/10.1016/j.amsu.2022.103914>.

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